

I claim:

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1. A compact electrically and optically pumped multiwavelength nanocavity array comprising a plurality of nanocavities, each nanocavity defined in a photonic crystal in which each nanocavity is lithographically formed to define a corresponding predetermined spectral response of each nanocavity, said plurality of nanocavities forming said array.

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1. The array of claim 1 where said spectral response which is lithographically formed defines wavelength supported by said nanocavity.

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1. The array of claim 1 where said spectral response which is lithographically formed defines polarization supported by said nanocavity.

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1. The array of claim 1 where said spectral response which is lithographically formed defines polarization and wavelength supported by said nanocavity.

1. The array of claim 1 wherein said array is a laser array.

1. The array of claim 1 wherein said array is a detector array.

- 1 7. The array of claim 1 wherein said array is an all optical gate.
- 1 8. The array of claim 1 wherein said array is an all optical router.
- 1 9. The array of claim 1 wherein said array is a modulator.
- 1 10. The array of claim 1 wherein said photonic crystal is formed in active quantum
2 well material.
- 1 11. The array of claim 1 wherein said nanocavities are vertical cavity surface emitting
2 lasers, VCSELs.
- 1 12. The array of claim 11 wherein said nanocavities each have a size and wherein
2 said size of each of said nanocavities is approximately a cubic half-wavelength.
- 1 13. The array of claim 1 said array is an array of lasers and where at least one
2 nanocavity laser is used as a pump for an adjacent nanocavity laser.
- 1 14. The array of claim 1 further comprising a nonlinear optical material filling said
2 photonic crystal.

1 15. The array of claim 14 wherein said array is a tunable nanocavity laser, detector,
2 router, gate or spectrometer array.

1 16. The array of claim 14 further comprising means for changing optical or electrical
2 properties of said nonlinear optical material in each of said nanocavities.

1 17. The array of claim 1 where said photonic crystals in said array are defined in Si-
2 Ge materials on silicon substrates disposed on insulators.

1 18. The array of claim 17 further comprising a silicon slab waveguide or integrated
2 circuit integrated with said array.

1 19. The array of claim 17 further comprising a nonlinear optical material filling said
2 photonic crystal and means for changing optical or electrical properties of said
3 nonlinear optical material in each of said nanocavities.

1 20. The array of claim 1 further comprising a waveguiding layer disposed adjacent to
2 said array, said waveguiding layer being transparent to light from said array and is
3 critically coupled to said nanocavities in said array.